Lexical Functional Grammar

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The constraint-based approach

Constraint-based theories (Lexical Functional Grammar, Head-Driven Phrase Structure Grammar, Construction Grammar, Categorial Grammar, Simpler Syntax ...):

- Different aspects of linguistic structure are realised by different but related linguistic representations. Movement/transformations do not play a role.

- "Semantic roles, syntactic constituents, and grammatical functions belong to parallel information structures of very different formal character. They are related not by proof-theoretic derivation but by structural correspondences, as a melody is related to the words of a song. The song is decomposable into parallel melodic and linguistic structures, which jointly constrain the nature of the whole. In the same way, the sentences of human language are themselves decomposable into parallel systems of constraints – structural, functional, semantic, and prosodic – which the whole must jointly satisfy." (Bresnan, 1990)

What theoretical architecture best reflects this view?

Theories and frameworks

Formal linguistic framework: A set of linguistic objects, rules, and/or processes, and a formal vocabulary for talking about them. Example: X-bar theory: phrase structure rules and trees.

- Formally explicit: Provides a way of making systematic, clear, and testable claims about phrase structure.

- Embodies some assumptions about how language works: phrases (like VP) have heads (like V),

- but general enough to encompass a range of different *theories* of phrase structure.

Theories and frameworks

Linguistic theory: A set of claims about the structure of language(s), which may (or may not) be stated with reference to a particular formal framework.

- Example: The claim that all maximal X-bar projections have bar level 2 (there is no N''' or V''''').

- A well-designed formal framework guides development of theory by providing explicit representations and theoretical vocabulary, and aids the linguist in developing better intuitions about language and (hence) better theories of linguistic structure.

Theories and frameworks: Other views

- Alternative view (NOT LFG): the formal framework should not allow the linguist to formulate rules or describe constructions that are linguistically impossible.

- This is a very strong view; e.g. disallows standard phrase structure rules, since impossible languages can be characterised with (unconstrained) phrase structure rules (e.g., a language where every sentence is at least 3000 words long).

- The LFG view (also HPSG, other constraint-based theories): use a simple, clean formal **framework**, and formulate linguistic **theory** as a set of claims stated with reference to the framework.

- Advantage: No need to throw away or reformulate the **framework** when revisions are needed to the **theory**.

LFG framework

Formal framework of LFG:

- Different aspects of linguistic structure are represented in different ways, and are related to one another by piecewise correspondence (parts of one structure are related to parts of another structure).

- The core of the formal framework of LFG has remained remarkably stable since its beginnings in the late 1970s.

- LFG-based theories of linguistic phenomena have evolved substantially since that time, and continue to evolve as new areas are explored and new theoretical proposals are formulated and evaluated.

LFG

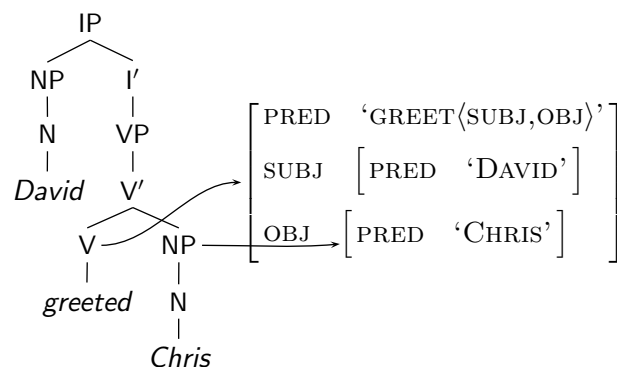Two aspects of syntactic structure:

- Functional structure is the abstract functional syntactic organisation of the sentence, familiar from traditional grammatical descriptions, representing syntactic predicate-argument structure and functional relations like subject and object.

- Constituent structure is the overt, more concrete level of linear and hierarchical organisation of words into phrases.
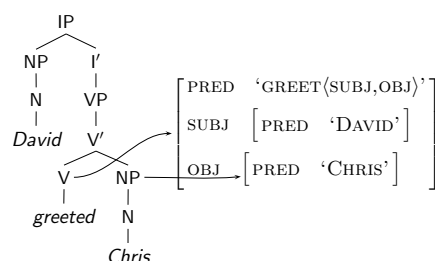
LFG's c-structure and f-structure

```
        IP
      /    \
    NP      I'
    |       |
    N       VP
    |       |
  David     V'
          /    \
         V      NP
         |      |
      greeted   N
                |
              Chris
```

$$\begin{bmatrix} \text{PRED} & \text{`GREET}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`CHRIS'} \end{bmatrix} \end{bmatrix}$$

C-structure and f-structure

```
        IP
      /    \
    NP      I'
    |       |
    N       VP
    |       |
  David     V'
          /    \
         V      NP
         |      |
      greeted   N
                |
              Chris
```

$$\begin{bmatrix} \text{PRED} & \text{`GREET}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`CHRIS'} \end{bmatrix} \end{bmatrix}$$

In GB/Principles and Parameters/Minimalism:

- C-structure = PF or Spellout?

- F-structure = S-Structure or LF?

Other linguistic levels

Since the inception of the theory, there has been much work on other linguistic levels and their relation to c-structure and f-structure:

- Argument structure and argument linking (Bresnan & Zaenen, 1990; Butt, 1995)

- The syntax-semantics interface: "glue" semantics (Dalrymple, 1999, 2001; Asudeh, 2004): interesting relations to categorial approaches, though with different assumptions about the relation to syntactic structure

- Information structure and its relation to syntax and semantics (Butt & King, 2000)

- Prosodic structure and its relation to syntax and semantics (Mycock, 2007)

LFG as a component of other approaches

LFG structures have also been explored as a component of OT and DOP:

- OT-LFG: Optimality-theoretic syntax with an LFG base (Bresnan, 2000)

- LFG-DOP: Data-Oriented Parsing with an LFG base (see
  http://www.nclt.dcu.ie/lfg-dop/publications.html)

F-structure

What information does functional structure represent?

- Abstract syntactic relations (familiar from traditional grammar) like subject, object, adjunct

- Locus of subcategorisation

- Criteria: anaphoric binding patterns, long-distance dependencies, control, honorification, agreement, casemarking, ...

- F-structure vocabulary is universal across languages

Functional Structure Diagnostics

How do we know what the functional structure for a sentence is?

- Honorification: Only the subject is the target of honorific verbs in Japanese

- Anaphora: The antecedent of a pronoun in Hindi cannot be the subject

- Relativisation: Only objects can be relativized with a gap in Kinyarwanda

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Grammatical functions

Non-argument		TOPIC	Discourse function
		FOCUS	
Argument (governable)	Core	SUBJ	
		OBJ	Non-discourse function
		OBJ$_\theta$	
	Non-core	OBL$_\theta$	
		COMP	
Non-argument		ADJ(unct)	

(from Börjars & Vincent 2004)

Objects

David gave George flowers.

$$
\begin{bmatrix}
\text{PRED} & \text{`GIVE}\langle\text{SUBJ,OBJ,OBJ}_{\text{THEME}}\rangle\text{'} \\
\text{TENSE} & \text{PAST} \\
\text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\
\text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`GEORGE'} \end{bmatrix} \\
\text{OBJ}_{\text{THEME}} & \begin{bmatrix} \text{PRED} & \text{`FLOWER'} \\ \text{NUM} & \text{PL} \end{bmatrix}
\end{bmatrix}
$$

OBJ$_\theta$ is a family of thematically restricted object functions. English, like many other languages, has only OBJ$_{\text{THEME}}$.

COMP

Chris thought that David yawned.

$$
\begin{bmatrix}
\text{PRED} & \text{`THINK}\langle\text{SUBJ,COMP}\rangle\text{'} \\
\text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`CHRIS'} \end{bmatrix} \\
\text{COMP} & \begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \\ \text{COMPFORM} & \text{THAT} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

Functional structure

$$
\begin{bmatrix}
\text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\
\text{TENSE} & \text{PAST} \\
\text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \\ \text{NUM} & \text{SG} \end{bmatrix}
\end{bmatrix}
$$

- ■ PRED, TENSE NUM: attributes

- ■ `GO$\langle$SUBJ$\rangle$', DAVID, SG: values

- ■ PAST, SG: symbols (a kind of value)

- ■ `BOY', `GO$\langle$SUBJ$\rangle$': semantic forms

F-structures

$$\begin{bmatrix} \text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{ADJ} & \left\{ \begin{bmatrix} \text{PRED} & \text{`QUICKLY'} \end{bmatrix} \right\} \end{bmatrix}$$

An f-structure can be the value of an attribute. Attributes with f-structure values are the grammatical functions: SUBJ, OBJ, OBJ$_\theta$, COMP, XCOMP, ...

F-structures

$$\begin{bmatrix} \text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{ADJ} & \left\{ \begin{bmatrix} \text{PRED} & \text{`QUICKLY'} \end{bmatrix} \right\} \end{bmatrix}$$

A set of f-structures can also be a value of an attribute.

Sets of f-structures

$$\begin{bmatrix} \text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \\ \text{SUBJ} & \left\{ \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \begin{bmatrix} \text{PRED} & \text{`GEORGE'} \end{bmatrix} \right\} \left\{ \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \begin{bmatrix} \text{PRED} & \text{`GEORGE'} \end{bmatrix} \right\} \\ \text{ADJ} & \left\{ \begin{bmatrix} \text{PRED} & \text{`QUICKLY'} \end{bmatrix} \right\} \left\{ \begin{bmatrix} \text{PRED} & \text{`QUICKLY'} \end{bmatrix} \right\} \end{bmatrix}$$

Sets of f-structures represent:

- adjuncts (there can be more than one adjunct) or

- coordinate structures (there can be more than one conjunct)

Describing F-structures

$(f \text{ NUM}) = \text{SG}$

is a functional equation.

$(f\ a) = v$ holds if and only if f is an f-structure, a is a symbol, and the pair $\langle a, v \rangle \in f$.

A set of formulas describing an f-structure is a functional description.

When does a functional equation hold?

$(g \text{ NUM}) = \text{SG}$

Holds of: $g\begin{bmatrix} \text{NUM} & \text{SG} \end{bmatrix}$

Also holds of: $g\begin{bmatrix} \text{PRED} & \text{`DAVID'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix}$

Which solution?: Minimality

The f-structure for an utterance is the minimal solution satisfying the constraints introduced by the words and phrase structure of the utterance.

F-description: $(g \text{ NUM}) = \text{SG}$

Its minimal solution: $g\begin{bmatrix} \text{NUM} & \text{SG} \end{bmatrix}$

More Complex Descriptions

$(f \text{ SUBJ NUM}) = \text{SG}$

$(f\ as) \equiv ((f\ a)\ s)$ for a symbol a and a (possibly empty) string of symbols s.

$(f\ \epsilon) \equiv f$, where ϵ is the empty string.

Solving Complex Descriptions

$(f \text{ SUBJ}(f \text{ SUBJ})g \text{ NUM}) = \text{SG}$

$f\begin{bmatrix} \text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\ \text{SUBJ} & g\begin{bmatrix} \text{PRED} & \text{`DAVID'} \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}$

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Finding the Right F-structure

Hindi verbs show person, number, and gender agreement:

	Ram	$(g \text{ PRED}) = \text{`RAM'}$
		$(g \text{ CASE}) = \text{NOM}$
		$(g \text{ PERS}) = 3$
		$(g \text{ NUM}) = \text{SG}$
Ram calegaa		$(g \text{ GEND}) = \text{MASC}$
Ram go.FUTURE	*calegaa*	$(f \text{ PRED}) = \text{`GO}\langle\text{SUBJ}\rangle\text{'}$
'Ram will go.'		$(f \text{ SUBJ CASE}) = \text{NOM}$
		$(f \text{ SUBJ PERS}) = 3$
		$(f \text{ SUBJ NUM}) = \text{SG}$
		$(f \text{ SUBJ GEND}) = \text{MASC}$

$$(f \text{ SUBJ}) = g$$

F-description and its solution

$(g \text{ PRED}) = \text{`RAM'}$
$(g \text{ CASE}) = \text{NOM}$
$(g \text{ PERS}) = 3$
$(g \text{ NUM}) = \text{SG}$
$(g \text{ GEND}) = \text{MASC}$

$(f \text{ PRED}) = \text{`GO}\langle\text{SUBJ}\rangle\text{'}$
$(f \text{ SUBJ CASE})(f \text{ SUBJ}) \text{CASE})g$
$\text{CASE}) = \text{NOM}$
$(f \text{ SUBJ PERS})(f \text{ SUBJ}) \text{PERS})g$
$\text{PERS}) = 3$
$(f \text{ SUBJ NUM})(f \text{ SUBJ}) \text{NUM})g$
$\text{NUM}) = \text{SG}$
$(f \text{ SUBJ GEND})(f \text{ SUBJ})$
$\text{GEND})g \text{ GEND}) = \text{MASC}$

$(f \text{ SUBJ}) = g$

$$f \begin{bmatrix} \text{PRED} & \text{`GO}\langle\text{SUBJ}\rangle\text{'} \\ \\ \text{SUBJ} & g \begin{bmatrix} \text{PRED} & \text{`RAM'} \\ \text{CASE} & \text{NOM} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEND} & \text{MASC} \end{bmatrix} \end{bmatrix}$$

Formal descriptions: LFG vs HPSG

- HPSG takes a different view of formal descriptions from LFG. The HPSG view goes back to Functional Unification Grammar (Kay, 1984), where unification (an operation on structures) was used to combine structures:

- in HPSG, the constraints look (as much as possible) like the structures.

- That is why you sometimes see a set of instructions in what looks like a representation – it is actually a constraint or description in the (apparent) form of a structure.

Formal descriptions: LFG vs HPSG

HPSG's Argument Realisation Principle (Sag et al., 2003, 432):

$$\textit{word}: \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \boxed{\text{A}} \\ \text{COMPS} & \boxed{\text{B}} \ominus \boxed{\text{C}} \end{bmatrix} \\ \text{GAP} & \boxed{\text{C}} \end{bmatrix} \\ \text{ARG-STR} & \boxed{\text{A}} \oplus \boxed{\text{B}} \end{bmatrix}$$

$\ominus$: list subtraction

$\oplus$: list addition

Generalisations and constructions

- Expressing generalisations over functional descriptions: **templates** (Dalrymple et al., 2004; Asudeh et al., 2008)

- Templates are names for bundles of functional equations that characterise a construction.

- Templates can be defined in terms of other templates, giving something like the inheritence hierarchy of HPSG (but involving relations among **descriptions** rather than **linguistic objects**).

- Templates can be associated with words or with units that are bigger than words, and are used to describe constructions in the Construction Grammar sense.

- This is a relatively recent area of exploration in LFG.

Semantic Forms

Subcategorisation requirements are imposed at f-structure (not c-structure) – a predicate specifies a set of grammatical functions, and the phrase structure grammar of the language determines where in the tree these functions can appear. Subcategorisation requirements are specified by **semantic forms**:

$(f \text{ PRED}) = \text{`GO}\langle \text{SUBJ} \rangle\text{'}$

Semantic forms have argument lists that list the arguments they require.

Completeness

Completeness requires: All arguments which are listed in the semantic form must be present.

$(f \text{ PRED}) = \text{`GO}\langle \text{SUBJ} \rangle\text{'}$

"Go" must have a SUBJ.

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Coherence

Coherence requires: No arguments which are not listed in the semantic form may be present.

$(f \text{ PRED}) =$ 'GO$\langle$SUBJ$\rangle$'

"Go" may not have a OBJ.

Completeness and coherence are the equivalent (more or less) of the Theta Criterion of GB theory, or the Valence Principle and Root Condition of HPSG.

Semantic arguments

Arguments which are associated with semantic roles appear inside the angled brackets and must have a PRED.

$(f \text{ PRED}) =$ 'GO$\langle$SUBJ$\rangle$'

The SUBJ of "go" must have a PRED.

Non-semantic arguments

Arguments which appear outside the angled brackets are syntactically but not semantically selected by the verb.

$(f \text{ PRED}) =$ 'RAIN$\langle\rangle$SUBJ'

"Rain" must have a SUBJ, but it is not assigned a semantic role by the predicate. (Other parts of the f-description ensure that the subject is "it".)

It rained.
 *Bill rained.
 *Rained.

Semantic Forms and Uniqueness

*wati   ka   parnka-mi   karnta
 man.ABS PRES run-NONPAST woman.ABS
'The man runs the woman.' (Warlpiri)

wati $(g \text{ PRED}) =$ 'MAN'
karnta $(g \text{ PRED}) =$ 'WOMAN'

Each use of a semantic form is unique.

Conflicting Semantic Forms

wati $(g$ PRED$) = $ 'MAN'
karnta $(g$ PRED$) = $ 'WOMAN'

Ill-formed f-structure:

$$\begin{bmatrix} \text{PRED} & \text{'RUN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PRES} \\ \text{SUBJ} & g\begin{bmatrix} \text{PRED} & \text{'MAN'/'WOMAN'} \end{bmatrix} \end{bmatrix}$$

Semantic forms and Uniqueness

Mirko ju   je   čitao.
Mirko it.ACC.CLITIC aux.3SG read
'Mirko read it.' (Serbo-Croatian)

Mirko je   čitao nju.
Mirko aux.3SG read it.ACC
'Mirko read it.'

    ju $(g$ PRED$) = $ 'PRO'
    nju $(g$ PRED$) = $ 'PRO'

$$\begin{bmatrix} \text{PRED} & \text{'READ}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'MIRKO'} \end{bmatrix} \\ \text{OBJ} & g\begin{bmatrix} \text{PRED} & \text{'PRO'} \end{bmatrix} \end{bmatrix}$$

Conflicting Semantic Forms

**Mirko ju   je   čitao nju.*
 Mirko it.ACC.CLITIC aux.3SG read it.ACC
'Mirko read it it.'

Ill-formed f-structure:

$$\begin{bmatrix} \text{PRED} & \text{'READ}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'MIRKO'} \end{bmatrix} \\ \text{OBJ} & g\begin{bmatrix} \text{PRED} & \text{'PRO}_1\text{'/'PRO}_2\text{'} \end{bmatrix} \end{bmatrix}$$

Optionality

njûchi zi-ná-lúm-a   *alenje*
bees   SUBJ-PAST-bite-INDICATIVE   hunters
'The bees bit the hunters.' (Chicheŵa)

zi-ná-lúm-a   *alenje*
SUBJ-PAST-bite-INDICATIVE   hunters
'They bit the hunters.'

zi-ná-lúm-a: $((f \text{ SUBJ PRED}) = \text{'PRO'})$

zi-ná-lúm-a optionally contributes a PRED for its SUBJ.

Overt subject

njûchi zi-ná-lúm-a   *alenje*
bees   SUBJ-PAST-bite-INDICATIVE   hunters
'The bees bit the hunters.'

$$f \begin{bmatrix} \text{PRED} & \text{'BITE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'BEES'} \\ \text{NOUNCLASS} & 10 \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'HUNTERS'} \\ \text{NOUNCLASS} & 2 \end{bmatrix} \end{bmatrix}$$

No overt subject

zi-ná-lúm-a   *alenje*
SUBJ-PAST-bite-INDICATIVE   hunters
'They bit the hunters.'

$$f \begin{bmatrix} \text{PRED} & \text{'BITE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'PRO'} \\ \text{NOUNCLASS} & 10 \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'HUNTERS'} \\ \text{NOUNCLASS} & 2 \end{bmatrix} \end{bmatrix}$$

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Optionality: Clitics

Juan vió a   Pedro.
Juan saw PREP Pedro
'Juan saw Pedro.' (Spanish)

Juan lo   vió.
Juan ACC.MASC.SG.CLITIC saw
'Juan saw him.'

Juan lo   vió a   Pedro.
Juan ACC.MASC.SG.CLITIC saw PREP Pedro
'Juan saw Pedro.'

Optionality: Clitics

Pedro $(f\ \text{PRED}) = \text{'PEDRO'}$
           $(f\ \text{GEND}) = \text{MASC}$
           $(f\ \text{NUM}) = \text{SG}$

lo $((f\ \text{PRED}) = \text{'PRO'})$
           $(f\ \text{GEND}) = \text{MASC}$
           $(f\ \text{NUM}) = \text{SG}$

lo optionally contributes a PRED.

Optionality: Clitics

Juan lo   vió a   Pedro.
Juan ACC.MASC.SG.CLITIC saw PREP Pedro
'Juan saw Pedro.'

$$
\begin{bmatrix}
\text{PRED} & \text{'SEE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\[4pt]
\text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'JUAN'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix} \\[12pt]
\text{OBJ}\quad f & \begin{bmatrix} \text{PRED} & \text{'PEDRO'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix}
\end{bmatrix}
$$

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Optionality and clitic doubling

Juan lo   vió.
Juan ACC.MASC.SG.CLITIC saw
'Juan saw him.'
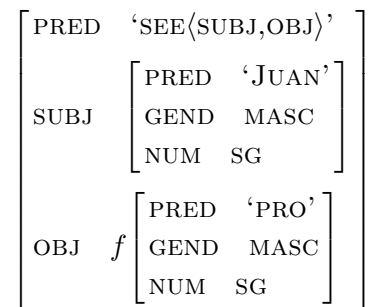
$$\begin{bmatrix} \text{PRED} & \text{`SEE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\[2ex] \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`JUAN'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix} \\[4ex] \text{OBJ} \quad f & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}$$

C-structure and f-structure

$$\begin{bmatrix} \text{PRED} & \text{`GREET}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`CHRIS'} \end{bmatrix} \end{bmatrix}$$
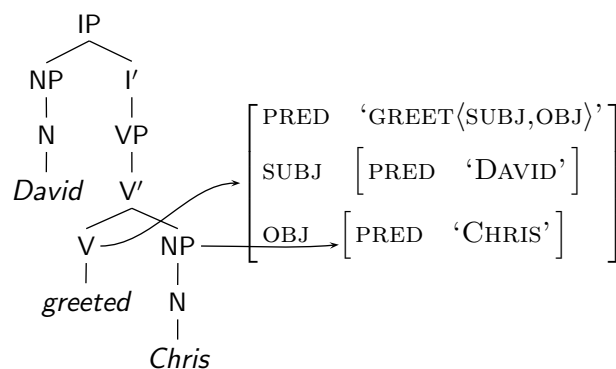
Motivating Constituent Structure

What information does constituent structure represent?

- Represents hierarchical phrasal groupings

- Criteria depend on surface syntactic properties, not semantic intuitions or facts about abstract functional syntactic structure

- Varies greatly across languages

Constituent Structure Diagnostics

How do we know what the constituent structure for a sentence is?

- Intonation: falling intonation on right edge of focused constituent in Russian

- Clitic placement: placement of possessive clitic on right edge of NP in English

- Verb-second: placement of verb after first constituent in Warlpiri

- Question formation: placement of single constituent in initial position in English

- Distribution of adverbs: placement of adverb between constituent daughters of VP or S in Icelandic

Constituent Structure Diagnostics

- Some theories (GB/Principles and Parameters, NOT LFG): Subjects always appear in the specifier of IP.

- LFG does not assume that subjects are defined in terms of phrase structure position, or that subjects must always appear in a particular position in the tree.

- However, there are structure-function mapping generalisations which state that phrases with particular functions tend to appear in particular phrase structure positions.

- In English, the specifier of IP is associated with the subject function; in other languages, it is associated with TOPIC or FOCUS. More below.

Lexical categories

Lexical categories are associated with open-class lexical items:

- N(oun), P(reposition), V(erb), A(djective), Adv(erb)

Functional categories

Functional categories are associated with closed-class lexical items, or a subset of open-class items. They are used when functional features are associated with positional properties (Börjars & Vincent, 2004).

- David is yawning.

- Is David yawning?

- David yawned.

- *Yawned David?

We will assume I (originally for Inflection) and C (originally for Complementizer).

X-Bar Theory

- X is a variable over category labels

- X projects an X′ phrase

- X′ projects an XP phrase

X-Bar Theory

```
        IP
       /  \
     NP    I′
      |   /  \
      N  I   VP
      |  |    |
   David is   V
              |
           yawning
```
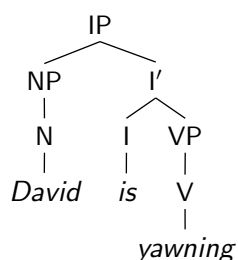
- I projects I′

- VP is a complement (sister) of I

- I′ projects IP

- NP is a specifier of I′

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Lexical Integrity

Lexical Integrity (Bresnan, 1982): Morphologically complete words are leaves of the c-structure tree, and each leaf corresponds to one and only one c-structure node.

English: cause to run

Japanese: *hasiraseta*
        run.CAUS.PAST

$$
\begin{bmatrix}
\text{PRED} & \text{`CAUS}\langle\text{SUBJ,OBJ,XCOMP}\rangle\text{'} \\
\text{SUBJ} & [\ ] \\
\text{OBJ} & [\ ] \\
\text{XCOMP} & \begin{bmatrix} \text{PRED} & \text{`RUN}\langle\text{SUBJ}\rangle\text{'} \\ \text{SUBJ} & \underline{\qquad} \end{bmatrix}
\end{bmatrix}
$$
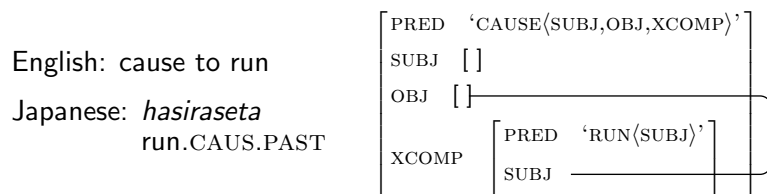
Words in one language can express the same f-structure as phrases in another language: Lexical Integrity holds at c-structure, not f-structure.

Economy of Expression

Economy of Expression (Bresnan, 2001): All syntactic phrase structure nodes are optional, and are not used unless required by independent principles (completeness, coherence, semantic expressivity).

```
        CP
        |
        C′
       /  \
      C    IP
      |   /  \
     Is  NP   I′
         |    |
         N    VP
         |    |
       David  V
              |
           yawning
```

```
         CP
        /  \
      NP    C′
      |     |
      N     IP
      |     |
    kogda   I′
     when  /  \
          I    VP
          |    |
      rodilsja NP
        born   |
               N
               |
           Lermontov
           Lermontov
```

'When was Lermontov born?'
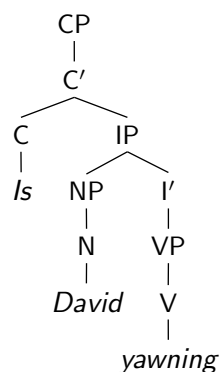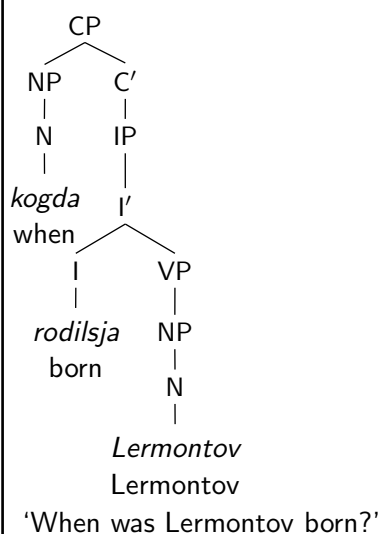
Exocentricity: the category S

Warlpiri:

```
                        IP
          ┌──────────────┴──────────────┐
          NP                            I′
          │                 ┌────────────┴────────────┐
          N                 I                          S
          │                 │           ┌──────────────┼──────────────┐
   kurdu-jarra-rlu       kapala         NP             V             NP
   child-DUAL-ERG         PRES          │              │              │
                                        N          wajilipi-nyi        N
                                        │          chase-NONPAST       │
                                     maliki                       wita-jarra-rlu
                                     dog.ABS                     small-DUAL-ERG
```
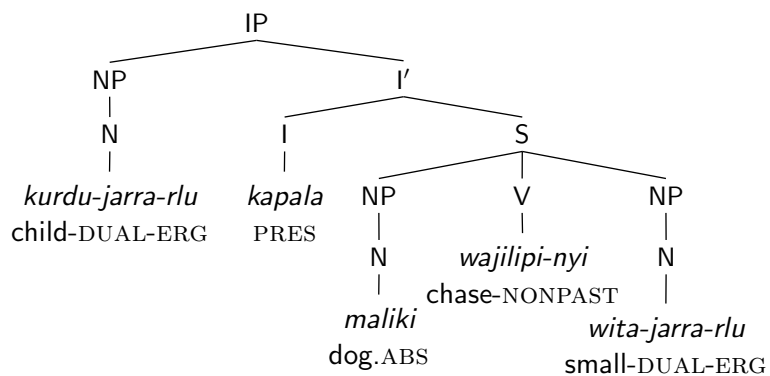
Not all languages make use of S (English doesn't).

Exocentricity

Exocentric categories (Kroeger, 1993; Bresnan, 2001):

- have no lexical head

- do not obey X′ theory

- can dominate either lexical or phrasal constituents

S can dominate a predicate and any or all of its arguments, including the SUBJ.

Phrase Structure Rules

V′   ⟶   V NP

Phrase structure rules are interpreted as node admissibility conditions: a phrase structure tree is admitted by a set of phrase structure rules if the rules license the tree.

Phrase Structure Rules

V′ ⟶ V (NP) PP*

The right hand side of a phrase structure rule is a regular expression: rich descriptive power, formally well-understood and computationally tractable.

Regular expressions allow:

- optionality

- disjunction

- repetition
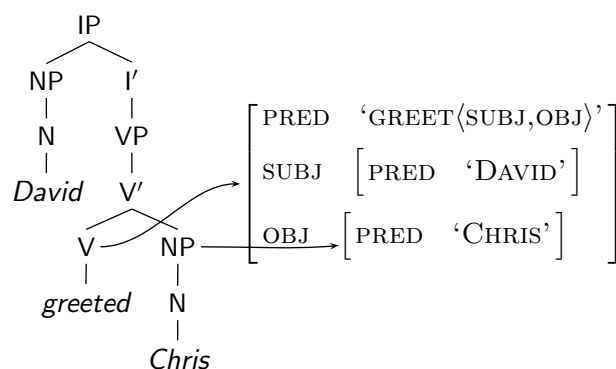
C-structure and f-structure
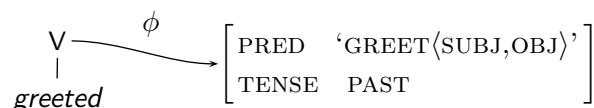
C- and F-Structure

ϕ function relates c-structure nodes to f-structures.

(Function: Every c-structure node corresponds to exactly one f-structure.)

Many Corresponding Nodes

```
VP
|        φ
V' ─────────→  ⎡ PRED   'GREET⟨SUBJ, OBJ⟩' ⎤
|              ⎣ TENSE   PAST               ⎦
V
|
greeted
```
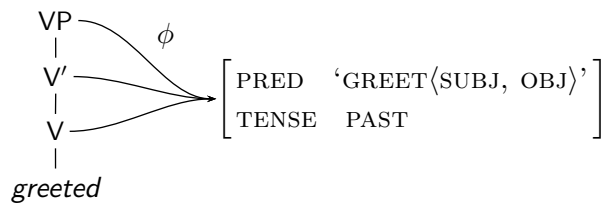
Many c-structure nodes can correspond to the same f-structure.

No Corresponding Node

```
S
|       φ
V ──────────→  ⎡ PRED   'BREAK⟨SUBJ⟩'        ⎤
|              ⎢ TENSE   PAST                ⎥
kowareta       ⎢ SUBJ   [ PRED   'PRO' ]     ⎥
break.PAST     ⎣                             ⎦
```
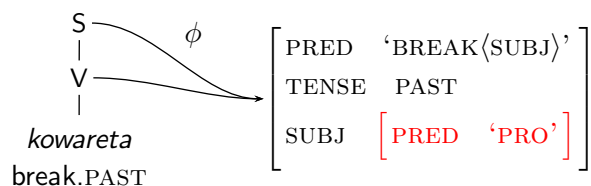
Some f-structures have no corresponding c-structure node.

These are formal, mathematical facts about the c-structure/f-structure relation. What are the linguistic facts?

Mapping regularities

C-structure heads are f-structure heads:

```
VP
|        φ
V' ─────────→  ⎡ PRED   'GREET⟨SUBJ, OBJ⟩' ⎤
|              ⎣ TENSE   PAST               ⎦
V
|
greeted
```
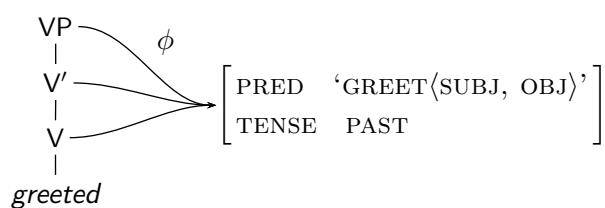
Mapping Regularities

Specifiers are filled by grammaticized discourse functions SUBJ, TOPIC, FOCUS.

Specifier of IP in English: SUBJ

$$\begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \end{bmatrix}$$
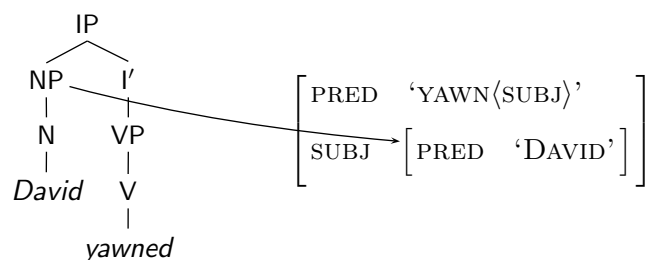
Mapping regularities

Specifier of IP in Russian: Topic or Focus

$$\begin{bmatrix} \text{PRED} & \text{`WRITE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{TOPIC} & \left\{ \begin{bmatrix} \text{PRED} & \begin{array}{l}\text{`EUGENE} \\ \text{ONEGIN'}\end{array} \end{bmatrix} \right\} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PUSHKIN'} \end{bmatrix} \\ \text{OBJ} & \rule{2cm}{0.4pt} \end{bmatrix}$$
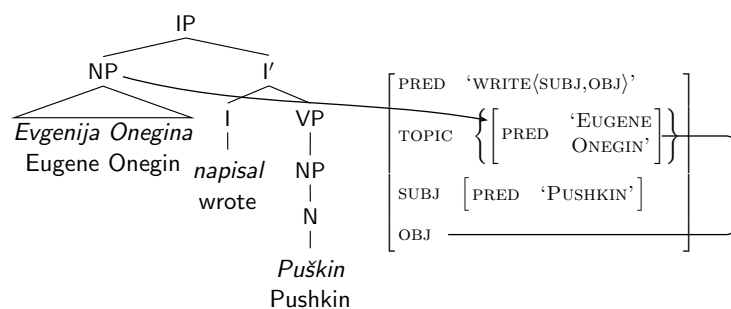
Mapping regularities

Specifier of IP in Bulgarian: Focus; Specifier of CP: Topic

$$\begin{bmatrix} \text{PRED} & \text{`DO}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{TOPIC} & \begin{bmatrix} \text{PRED} & \text{`IVAN'} \end{bmatrix} \\ \text{SUBJ} & \rule{2cm}{0.4pt} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{`WHAT'} \end{bmatrix} \\ \text{OBJ} & \rule{2cm}{0.4pt} \end{bmatrix}$$
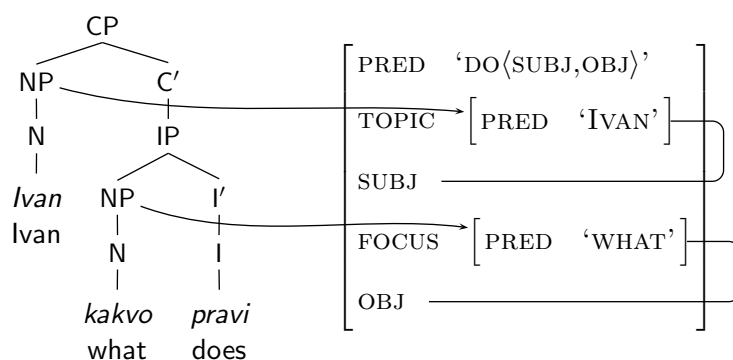
Mapping regularities

Specifier of CP in English: Focus

CP tree: NP (N, *What*) and C' (C, *is*; IP). IP → NP (N, *David*) and I' (VP → V, *eating*).

$$\begin{bmatrix} \text{PRED} & \text{`EAT}\langle\text{SUBJ},\text{OBJ}\rangle\text{'} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{`WHAT'} \end{bmatrix} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \\ \text{OBJ} & \end{bmatrix}$$
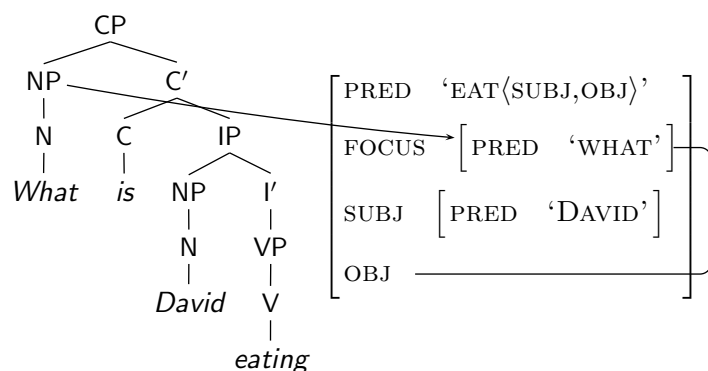
Mapping regularities

Specifier of CP in Finnish: Focus

CP tree: NP (N, *Mikolta* / Mikko.ABL) and C' (IP). IP → NP (N, *Anna* / Anna) and I' (I, *sai* / got; VP → NP → N, *kukkia* / flowers.PART).

$$\begin{bmatrix} \text{PRED} & \text{`GET}\langle\text{SUBJ},\text{OBJ},\text{OBL}_{\text{SOURCE}}\rangle\text{'} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{`MIKKO'} \end{bmatrix} \\ \text{OBL}_{\text{SOURCE}} & \\ \text{TOPIC} & \begin{bmatrix} \text{PRED} & \text{`ANNA'} \end{bmatrix} \\ \text{SUBJ} & \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`FLOWERS'} \end{bmatrix} \end{bmatrix}$$
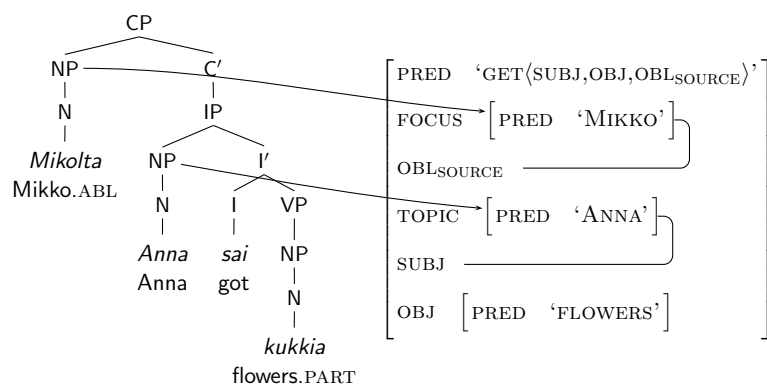
Complements: Functional Categories

Complement of functional category is f-structure co-head:
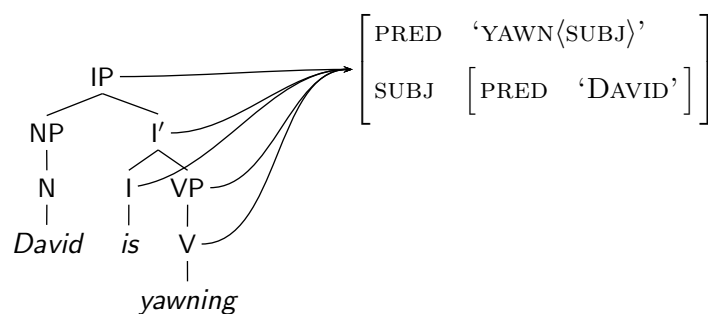
IP tree: NP (N, *David*) and I' (I, *is*; VP → V, *yawning*).

$$\begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \end{bmatrix}$$

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Complements: Functional Categories

IP
NP — I′
N — I — VP
Anna — budet — V′
Anna — FUTURE — V — NP
čitat′ — N
read.INF — knigu
book

$$\begin{bmatrix} \text{PRED} & \text{‘READ}\langle\text{SUBJ,OBJ}\rangle\text{’} \\ \text{TENSE} & \text{FUTURE} \\ \text{TOPIC} & \left\{\begin{bmatrix}\text{PRED} & \text{‘ANNA’}\end{bmatrix}\right\} \\ \text{SUBJ} & \underline{\hspace{3cm}} \\ \text{OBJ} & \begin{bmatrix}\text{PRED} & \text{‘BOOK’}\end{bmatrix} \end{bmatrix}$$
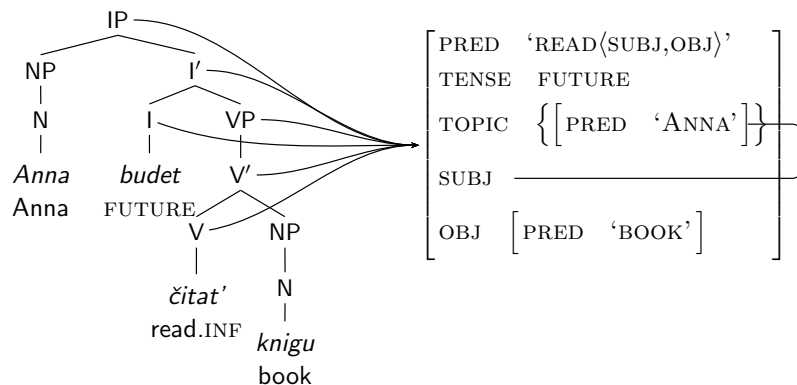
Complements of Lexical Categories

Complement of lexical category is f-structure complement (non-subject argument):
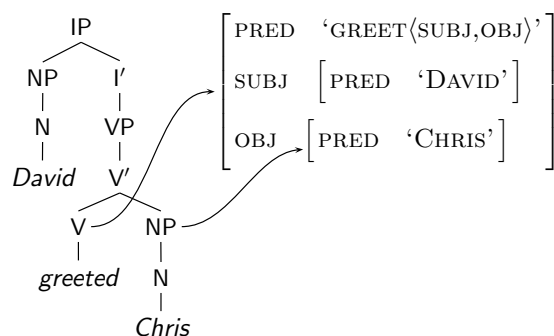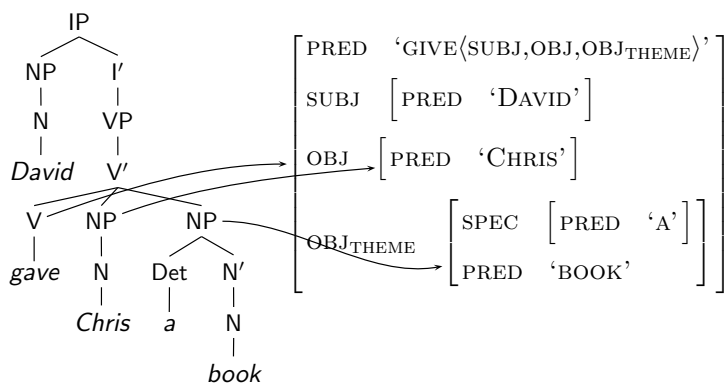
IP
NP — I′
N — VP
David — V′
V — NP
greeted — N
Chris

$$\begin{bmatrix} \text{PRED} & \text{‘GREET}\langle\text{SUBJ,OBJ}\rangle\text{’} \\ \text{SUBJ} & \begin{bmatrix}\text{PRED} & \text{‘DAVID’}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{PRED} & \text{‘CHRIS’}\end{bmatrix} \end{bmatrix}$$

Complements of Lexical Categories

IP
NP — I′
N — VP
David — V′
V — NP — NP
gave — N — Det — N′
Chris — a — N
book

$$\begin{bmatrix} \text{PRED} & \text{‘GIVE}\langle\text{SUBJ,OBJ,OBJ}_{\text{THEME}}\rangle\text{’} \\ \text{SUBJ} & \begin{bmatrix}\text{PRED} & \text{‘DAVID’}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{PRED} & \text{‘CHRIS’}\end{bmatrix} \\ \text{OBJ}_{\text{THEME}} & \begin{bmatrix}\text{SPEC} & \begin{bmatrix}\text{PRED} & \text{‘A’}\end{bmatrix} \\ \text{PRED} & \text{‘BOOK’}\end{bmatrix} \end{bmatrix}$$

Complements of Lexical Categories

Complement of lexical category can be f-structure co-head:

IP tree diagram:
- IP
  - NP
    - N
      - *David*
  - I′
    - I
      - *has*
    - VP
      - V′
        - V
          - *been*
        - VP
          - V
            - *yawning*

$$\begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PRES} \\ \text{ASPECT} & \text{PERFECT.PROGRESSIVE} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`DAVID'} \end{bmatrix} \end{bmatrix}$$
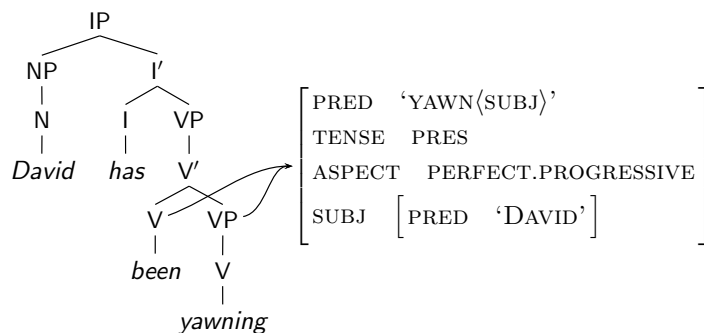
Constraining the c-structure/f-structure correspondence

V′ — ϕ →
- V′
  - V
    - *yawned*

$$\begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \end{bmatrix}$$

V′ $\longrightarrow$ V
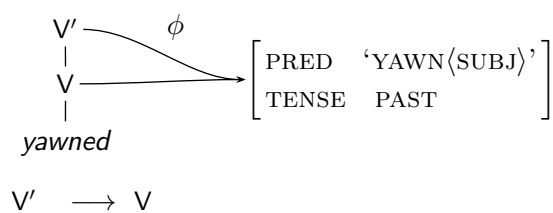
Local F-Structure Reference

V′ — ϕ →
- V′
  - V
    - *yawned*

$$\begin{bmatrix} \text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \end{bmatrix}$$

V′ $\longrightarrow$ V
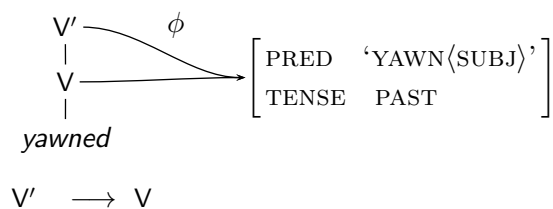
the current c-structure node ("self"):	$*$
the immediately dominating node ("mother"):	$\widehat{*}$
the c-structure to f-structure function:	ϕ

Rule Annotation

$$
\text{V}' \xrightarrow{\ \phi\ } \begin{bmatrix} \text{PRED} & \text{'YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \end{bmatrix}
$$

V'
|
V
|
yawned
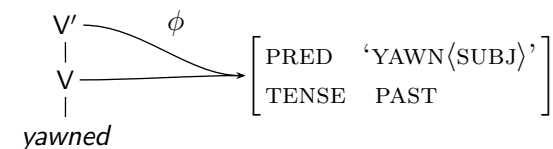
$$\text{V}' \longrightarrow \text{V}$$
$$\phi(\widehat{*}) = \phi(*)$$
mother's (V''s) f-structure = self's (V's) f-structure

Simplifying the Notation

$\phi(\widehat{*})$ (mother's f-structure) $= \uparrow$
$\phi(*)$ (self's f-structure) $= \downarrow$
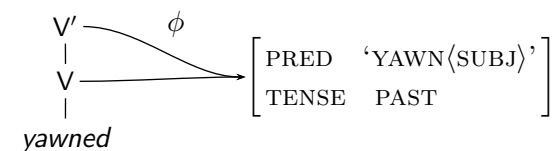
$$
\text{V}' \xrightarrow{\ \phi\ } \begin{bmatrix} \text{PRED} & \text{'YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \end{bmatrix}
$$

V'
|
V
|
yawned

$$\text{V}' \longrightarrow \text{V}$$
$$\uparrow = \downarrow$$
mother's f-structure = self's f-structure

Using the Notation

$$\text{V}' \longrightarrow \text{V}$$
$$\uparrow = \downarrow$$
mother's f-structure = self's f-structure

V' ⟶ [ ]
|
V
$\uparrow = \downarrow$
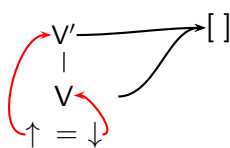
More rules

$$\text{V}' \longrightarrow \text{V} \qquad\qquad \text{NP}$$
$$\phi(\widehat{*}) = \phi(*) \qquad (\phi(\widehat{*})\ \text{OBJ}) = \phi(*)$$
mother's f-structure's OBJ = self's f-structure

In simpler form:

$$\text{V}' \longrightarrow \text{V} \qquad \text{NP}$$
$$\uparrow = \downarrow \qquad (\uparrow\ \text{OBJ}) = \downarrow$$

Using the Notation

V′ ⟶   V   NP
           ↑ = ↓   (↑ OBJ) = ↓

V′ ⟶ $\Big[$ OBJ ⟶ [ ] $\Big]$

V NP

Terminal nodes

V
|
yawned ⟶ $\begin{bmatrix} \text{PRED} & \text{'YAWN}\langle\text{SUBJ}\rangle\text{'} \\ \text{TENSE} & \text{PAST} \end{bmatrix}$
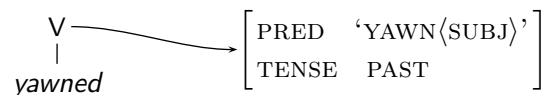
Expressible as:

V ⟶   *yawned*
       (↑ PRED) = 'YAWN⟨SUBJ⟩'
         (↑ TENSE) = PAST

Standard form:

yawned   V   (↑ PRED) = 'YAWN⟨SUBJ⟩'
            (↑ TENSE) = PAST

Phrase structure rules: English

IP ⟶ $\left(\begin{array}{c} \text{NP} \\ (\uparrow \text{ SUBJ}) = \downarrow \end{array} \right)$ $\left(\begin{array}{c} \text{I}' \\ \uparrow = \downarrow \end{array} \right)$

I′ ⟶ $\left(\begin{array}{c} \text{I} \\ \uparrow = \downarrow \end{array} \right)$ $\left(\begin{array}{c} \text{VP} \\ \uparrow = \downarrow \end{array} \right)$

VP ⟶ $\left(\begin{array}{c} \text{V} \\ \uparrow = \downarrow \end{array} \right)$

NP ⟶ $\left(\begin{array}{c} \text{N} \\ \uparrow = \downarrow \end{array} \right)$

Lexical entries: English

yawned   V   (↑ PRED) = 'YAWN⟨SUBJ⟩'
            (↑ TENSE) = PAST

David   N   (↑ PRED) = 'DAVID'

(Standard LFG practice: include only features relevant for analysis under discussion.)

Analysis: English

$$
\begin{array}{c}
\text{IP} \\
\diagdown \\
\text{NP} \qquad\qquad \text{I}' \\
(\uparrow f_{ip}\ \text{SUBJ}) = \downarrow f_{np} \qquad \uparrow f_{ip} = \downarrow f_{i'} \\
| \qquad\qquad | \\
\text{N} \qquad\qquad \text{VP} \\
\uparrow f_{np} = \downarrow f_n \qquad \uparrow f_{i'} = \downarrow f_{vp} \\
| \qquad\qquad | \\
\textit{David} \qquad\qquad \text{V} \\
(\uparrow f_n\ \text{PRED}) = \text{`DAVID'} \qquad \uparrow f_{vp} = \downarrow f_v \\
| \\
\textit{yawned} \\
(\uparrow f_v\ \text{PRED}) = \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\
(\uparrow f_v\ \text{TENSE}) = \text{PAST}
\end{array}
$$
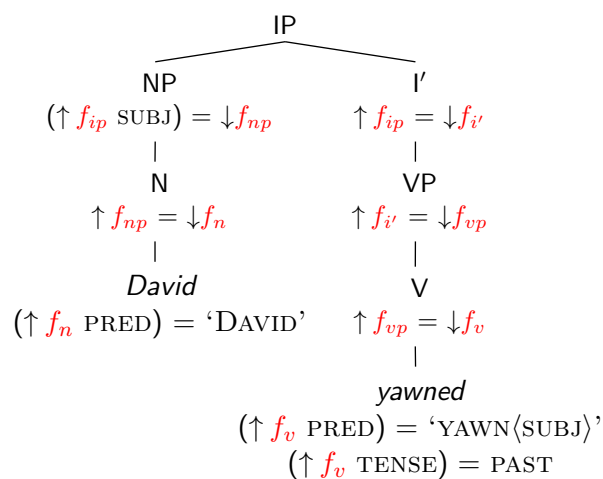
Solving the Description

$(f_{ip}\ \text{SUBJ}) = f_{np}$
$f_{np} = f_n$
$(f_n\ \text{PRED}) = \text{`DAVID'}$
$f_{ip} = f_{i'}$
$f_{i'} = f_{vp}$
$f_{vp} = f_v$
$(f_v\ \text{PRED}) = \text{`YAWN}\langle\text{SUBJ}\rangle\text{'}$
$(f_v\ \text{TENSE}) = \text{PAST}$

$$
\begin{array}{l}
f_{ip} \\
f_{i'} \\
f_{vp} \\
f_v
\end{array}
\left[
\begin{array}{ll}
\text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\
\text{TENSE} & \text{PAST} \\
\text{SUBJ} & \begin{array}{l} f_{np} \\ f_n \end{array} \big[\, \text{PRED} \quad \text{`DAVID'} \,\big]
\end{array}
\right]
$$

Final result

$$
\begin{array}{c}
\text{IP} \\
\text{NP} \qquad \text{I}' \\
(f_{ip}\ \text{SUBJ}) = f_{np} \qquad f_{ip} = f_{i'} \\
| \qquad | \\
\text{N} \qquad \text{VP} \\
f_{np} = f_n \qquad f_{i'} = f_{vp} \\
| \qquad | \\
\textit{David} \qquad \text{V} \\
(f_n\ \text{PRED}) = \text{`DAVID'} \qquad f_{vp} = f_v \\
| \\
\textit{yawned} \\
(f_v\ \text{PRED}) = \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\
(f_v\ \text{TENSE}) = \text{PAST}
\end{array}
$$

$$
\left[
\begin{array}{ll}
\text{PRED} & \text{`YAWN}\langle\text{SUBJ}\rangle\text{'} \\
\text{TENSE} & \text{PAST} \\
\text{SUBJ} & \big[\, \text{PRED} \quad \text{`DAVID'} \,\big]
\end{array}
\right]
$$

Warlpiri

$\text{GF} \equiv \{\text{SUBJ} \mid \text{OBJ} \mid \text{OBL}_\theta\}$

$$\text{IP} \longrightarrow \begin{pmatrix} \text{NP} \\ (\uparrow \text{FOCUS}) = \downarrow \\ (\uparrow \text{GF}) = \downarrow \end{pmatrix} \begin{pmatrix} \text{I}' \\ \uparrow = \downarrow \end{pmatrix}$$

$$\text{I}' \longrightarrow \begin{pmatrix} \text{I} \\ \uparrow = \downarrow \end{pmatrix} \begin{pmatrix} \text{S} \\ \uparrow = \downarrow \end{pmatrix}$$

$$\text{S} \longrightarrow \{ \begin{matrix} \text{NP} \\ (\uparrow \text{GF}) = \downarrow \end{matrix} \mid \begin{matrix} \text{V} \\ \uparrow = \downarrow \end{matrix} \}^*$$

Warlpiri verbs

panti-rni V $(\uparrow \text{PRED}) = \text{`SPEAR}\langle\text{SUBJ},\text{OBJ}\rangle\text{'}$
$((\uparrow \text{SUBJ PRED}) = \text{`PRO'})$
$(\uparrow \text{SUBJ CASE}) = \text{ERG}$
$((\uparrow \text{OBJ PRED}) = \text{`PRO'})$
$(\uparrow \text{OBJ CASE}) = \text{ABS}$

Warlpiri

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Chichewa

$$S \longrightarrow \begin{pmatrix} NP \\ (\uparrow \text{ SUBJ}) = \downarrow \end{pmatrix}, \begin{pmatrix} NP \\ (\uparrow \text{ TOPIC}) = \downarrow \end{pmatrix}, \begin{pmatrix} VP \\ \uparrow = \downarrow \end{pmatrix}$$

$$VP \longrightarrow \begin{pmatrix} V' \\ \uparrow = \downarrow \end{pmatrix}$$

$$V' \longrightarrow \begin{pmatrix} V \\ \uparrow = \downarrow \end{pmatrix} \begin{pmatrix} NP \\ (\uparrow \text{ OBJ}) = \downarrow \end{pmatrix}$$

Comma between daughters in S rule: daughters of S are unordered

---

Chichewa verbs

zi-ná-wá-lum-a   V $(\uparrow \text{ PRED}) = \text{'BITE}\langle\text{SUBJ,OBJ}\rangle\text{'}$
$((\uparrow \text{ SUBJ PRED}) = \text{'PRO'})$
$(\uparrow \text{ SUBJ NOUNCLASS}) = 10$
$(\uparrow \text{ OBJ PRED}) = \text{'PRO'}$
$(\uparrow \text{ OBJ NOUNCLASS}) = 2$

Chichewa

$$\begin{bmatrix} \text{PRED} & \text{'BITE}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'BEES'} \\ \text{NOUNCLASS} & 10 \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'PRO'} \\ \text{NOUNCLASS} & 2 \end{bmatrix} \end{bmatrix}$$

S

NP $(\uparrow \text{ SUBJ})=\downarrow$ VP $\uparrow=\downarrow$

njûchi bees
$(\uparrow \text{ PRED}) = \text{'BEES'}$
$(\uparrow \text{ NOUNCLASS}) = 10$

V' $\uparrow=\downarrow$

V

zi-ná-wá-lum-a
SUBJ-PAST-OBJ-bite-INDICATIVE
$(\uparrow \text{ PRED}) = \text{'BITE}\langle\text{SUBJ,OBJ}\rangle\text{'}$
$((\uparrow \text{ SUBJ PRED}) = \text{'PRO'})$
$(\uparrow \text{ SUBJ NOUNCLASS}) = 10$
$(\uparrow \text{ OBJ PRED}) = \text{'PRO'}$
$(\uparrow \text{ OBJ NOUNCLASS}) = 2$

Chichewa

```
S
|
VP
↑=↓
|
V'
↑=↓
```

```
V
|
zi-ná-lum-a
SUBJ-PAST-OBJ-bite-INDICATIVE
(↑ PRED) = 'BITE⟨SUBJ,OBJ⟩'
((↑ SUBJ PRED) = 'PRO')
(↑ SUBJ NOUNCLASS) = 10
```

```
NP
(↑ OBJ)=↓
|
alenje
hunters
(↑ PRED) = 'HUNTER'
(↑ NOUNCLASS) = 10
```

$$\begin{bmatrix} \text{PRED} & \text{'BITE⟨SUBJ,OBJ⟩'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'PRO'} \\ \text{NOUNCLASS} & 10 \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'HUNTER'} \\ \text{NOUNCLASS} & 2 \end{bmatrix} \end{bmatrix}$$

Bulgarian

$$\text{IP} \longrightarrow \begin{pmatrix} \text{NP} \\ (\uparrow \text{ FOCUS}) = \downarrow \\ (\uparrow \text{ GF}) = \downarrow \end{pmatrix} \begin{pmatrix} \text{I'} \\ \uparrow = \downarrow \end{pmatrix}$$

$$\text{I'} \longrightarrow \begin{pmatrix} \text{I} \\ \uparrow = \downarrow \end{pmatrix} \begin{pmatrix} \text{S} \\ \uparrow = \downarrow \end{pmatrix}$$

$$\text{I} \longrightarrow \begin{pmatrix} \text{Cl} \\ (\uparrow \text{ OBJ}) = \downarrow \end{pmatrix} \begin{pmatrix} \text{I} \\ \uparrow = \downarrow \end{pmatrix}$$

$$\text{S} \longrightarrow \{ \begin{matrix} \text{NP} \\ (\uparrow \text{ GF}) = \downarrow \end{matrix} \ | \ \begin{matrix} \text{V} \\ \uparrow = \downarrow \end{matrix} \}^*$$
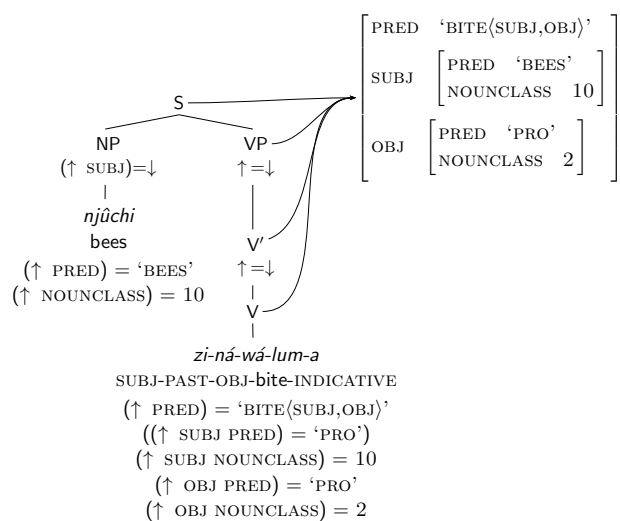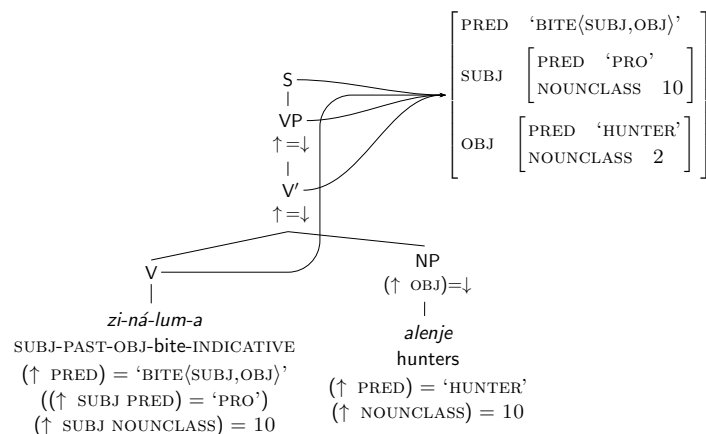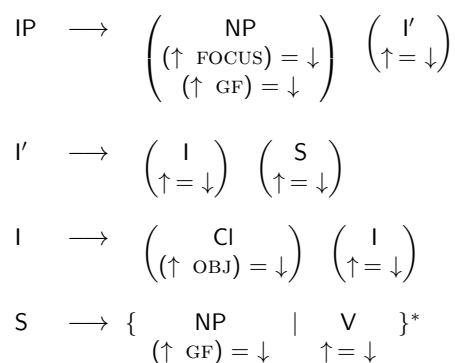
Bulgarian verbs

vidja   V   (↑ PRED) = 'SEE⟨SUBJ,OBJ⟩'
((↑ SUBJ PRED) = 'PRO')
(↑ SUBJ PERS) = 3
(↑ SUBJ NUM) = SG
(↑ SUBJ CASE) = NOM
(↑ OBJ CASE) = ACC

Bulgarian clitics

ja   ((↑ PRED) = 'PRO')
(↑ PERS) = 3
(↑ NUM) = SG
(↑ GEND) = FEM
(↑ CASE) = ACC

Bulgarian

IP
NP
($\uparrow$ FOCUS)=$\downarrow$
($\uparrow$ GF)=$\downarrow$

I′
$\uparrow$=$\downarrow$

N
$\uparrow$=$\downarrow$

I
$\uparrow$=$\downarrow$

S
$\uparrow$=$\downarrow$

Knigata
book.FEM.3SG
($\uparrow$ PRED) = 'BOOK'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = FEM

vidja
see.PAST.3SG
($\uparrow$ PRED) = 'SEE⟨SUBJ,OBJ⟩'
(($\uparrow$ SUBJ PRED) = 'PRO')
($\uparrow$ SUBJ PERS) = 3
($\uparrow$ SUBJ NUM) = SG
($\uparrow$ SUBJ CASE) = NOM
($\uparrow$ OBJ CASE) = ACC

NP
($\uparrow$ GF)=$\downarrow$

N

Georgi
Georgi.MASC.3SG
($\uparrow$ PRED) = 'GEORGI'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = MASC

$$\begin{bmatrix} \text{PRED} & \text{'SEE⟨SUBJ,OBJ⟩'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'GEORGI'} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEND} & \text{MASC} \\ \text{CASE} & \text{NOM} \end{bmatrix} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{'BOOK'} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEND} & \text{FEM} \\ \text{CASE} & \text{ACC} \end{bmatrix} \\ \text{OBJ} & \end{bmatrix}$$
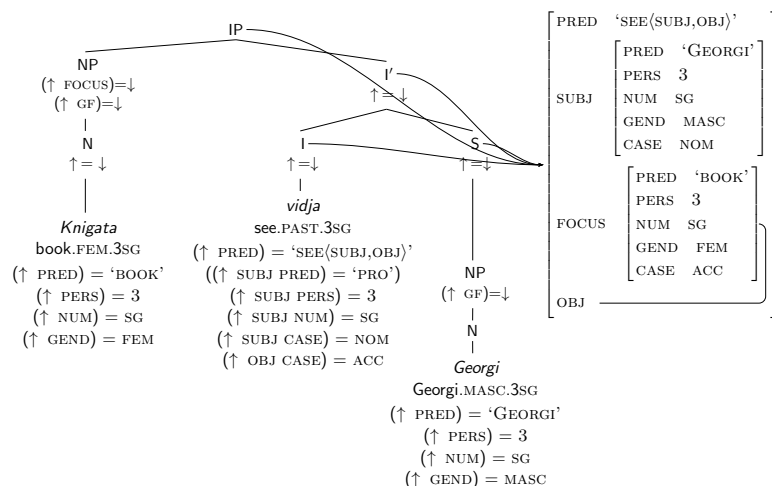
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Bulgarian

IP
NP
($\uparrow$ FOCUS) = $\downarrow$
($\uparrow$ GF)=$\downarrow$

I′

N
$\uparrow$=$\downarrow$

I
$\uparrow$=$\downarrow$

S
$\uparrow$=$\downarrow$

Decata
children
($\uparrow$ PRED) = 'CHILDREN'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = PL

vidja
see.PAST.3SG
($\uparrow$ PRED) = 'SEE⟨SUBJ,OBJ⟩'
(($\uparrow$ SUBJ PRED) = 'PRO')
($\uparrow$ SUBJ PERS) = 3
($\uparrow$ SUBJ NUM) = SG
($\uparrow$ SUBJ CASE) = NOM
($\uparrow$ OBJ CASE) = ACC

NP
($\uparrow$ GF)=$\downarrow$

N
$\uparrow$=$\downarrow$

Georgi
Georgi.MASC.3SG
($\uparrow$ PRED) = 'GEORGI'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = MASC

$$\begin{bmatrix} \text{PRED} & \text{'SEE⟨SUBJ,OBJ⟩'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'GEORGI'} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEND} & \text{MASC} \\ \text{CASE} & \text{NOM} \end{bmatrix} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{'CHILDREN'} \\ \text{PERS} & 3 \\ \text{NUM} & \text{PL} \\ \text{CASE} & \text{ACC} \end{bmatrix} \\ \text{OBJ} & \end{bmatrix}$$

Lexical Functional Grammar – 102 / 105

Bulgarian

IP
NP
($\uparrow$ FOCUS) = $\downarrow$
($\uparrow$ GF)=$\downarrow$

I′

N
$\uparrow$=$\downarrow$

I
$\uparrow$=$\downarrow$

S
$\uparrow$=$\downarrow$

Georgi
Georgi.MASC.3SG
($\uparrow$ PRED) = 'GEORGI'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = MASC

Cl
($\uparrow$ OBJ)=$\downarrow$

ja
her.OBJ.CLITIC
(($\uparrow$ PRED) = 'PRO')
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = FEM
($\uparrow$ CASE) = ACC

I
$\uparrow$=$\downarrow$

gleda
watch.3SG
($\uparrow$ PRED) = 'SEE⟨SUBJ,OBJ⟩'
(($\uparrow$ SUBJ PRED) = 'PRO')
($\uparrow$ SUBJ PERS) = 3
($\uparrow$ SUBJ NUM) = SG
($\uparrow$ SUBJ CASE) = NOM
($\uparrow$ OBJ CASE) = ACC

NP
($\uparrow$ GF)=$\downarrow$

N
$\uparrow$=$\downarrow$

Marija
Marija
($\uparrow$ PRED) = 'MARIJA'
($\uparrow$ PERS) = 3
($\uparrow$ NUM) = SG
($\uparrow$ GEND) = FEM

$$\begin{bmatrix} \text{PRED} & \text{'WATCH⟨SUBJ,OBJ⟩'} \\ \text{FOCUS} & \begin{bmatrix} \text{PRED} & \text{'GEORGI'} \\ \text{GEND} & \text{MASC} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{CASE} & \text{NOM} \end{bmatrix} \\ \text{SUBJ} & \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'MARIJA'} \\ \text{GEND} & \text{FEM} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{CASE} & \text{ACC} \end{bmatrix} \end{bmatrix}$$

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